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RECOGNISING ACHIEVEMENT

GCSE

Applied Science Double Award

General Certificate of Secondary Education **J649**

Report on the Units

June 2009

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This report on the Examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the syllabus content, of the operation of the scheme of assessment and of the application of assessment criteria.

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REPORTS ON THE UNITS

Chief Examiner's Report

General Comments

In the examinations, candidates were appropriately entered for the Foundation tier paper, with most showing knowledge across all question areas. At this level, candidates made good use of time, with very few part questions left unattempted.

There was evidence to suggest, however, that a significant number of candidates were inappropriately prepared for the higher tier paper. In particular, many appeared unfamiliar with specification content required at this level. Please note also that the higher tier paper is designed to differentiate between higher grades and many of the questions require knowledge specific to the higher tier and many questions require candidates to analyse and present answers at a much higher level than on the foundation paper.

It is expected that candidates on both tiers are able to give appropriate definitions or explanations of scientific terms in the specification. This continues to be a general weakness; Centres need to work on improving candidates' knowledge and understanding of 'key' words that define the most important learning objectives on the specification, and knowledge of chemical symbols and formulae cited in the appendices of the specification.

In the portfolio units, please ensure that OCR's URS form is completed for each candidate, with the Centre and each candidate's name and number. It would also assist in the moderation process if Centres recorded assessment information on OCR's recommended tracking grid, which can be found in the appendices of this document. Please present portfolio work in envelope folders or cut-flush files, or tied together using treasury tags, and *not* in plastic wallets.

Practical activities selected by many Centres were often in the true spirit of the course, being applied in nature and often excellent examples of work-related learning. For those Centres that are less sure in their development of practical activities, please refer to the appendices of this document, where a list of assignments illustrating best practice is provided.

A major issue in both portfolio units continues to be candidates' recording, display and processing of data. Candidates must **not** be awarded a Band 3 if key features such as correct table headings and units are missing, or there is no consideration of a use of significant figures in calculations. The attention of Centres needs also to be drawn to conclusions and evaluations at Bands 2 and 3. Note that in B481, *simple* scientific knowledge should be used to explain findings at Band 2 (detailed knowledge and understanding is required at Band 3). *All* candidates should attempt evaluations, and appropriate scientific terminology must be used to procure Band 3.

B481: Developing Scientific Skills (Portfolio)

General Comments

In this session, the majority of Centres is to be commended for the way in which this unit has been implemented and delivered. Administration has, on the whole, been efficient, though Centres must guard against arithmetical errors when calculating final marks for the units, and clerical errors in the transfer of these onto the OCR Interchange or MS1s.

Centres must also make careful checks on the way the assessment criteria are being translated into marks, and guidance on this from the specification is reproduced in Appendices II and III. Any Centres that might remain unsure of how to apply the assessment criteria accurately should seek further guidance from OCR.

In this session, many Centres had ensured that internal standardisation procedures had been carried out, and documentary evidence of this was supplied. In a minority, however, the lack of these procedures was evident in inconsistent marking between different teachers, and this is an important issue that has to be resolved.

For B481, it was apparent that Centres had ensured diligently that candidates had fulfilled the requirements of the assessment evidence grids, but it should also be noted that due consideration should be paid to appropriate coverage of the Assessment Objectives of the unit (Centres should refer to page 97 of the specification), and Performance Descriptions (pages 114 and 115). One important issue observed in write ups of standard procedures by higher ability candidates was that in many instances, only a limited attempt had been made to relate experimental findings to scientific principles (AO2).

The most successful implementation of the specification has been observed in Centres that have taken a holistic view of the course. The course rationale, highlighted in the specification, involves candidates obtaining and developing the necessary knowledge and understanding of science (Unit 2), developing and carrying out underpinning practical skills in Unit 1, and then *applying* practical skills and a knowledge and understanding of science in Unit 3. Several Centres have been seen to develop further themes initiated in previous sessions.

Centres should also take particular note of the presentation of candidates' portfolios. It would greatly assist the moderation process if candidates' portfolios were presented in cardboard wallets or cut-flush folders, or bound with treasury tags; please do not enclose portfolio material in plastic wallets.

Comments on activities chosen

Many Centres, in particular those who are becoming more experienced with Applied Science, have adopted a truly vocational approach, linking in with local industries and thereby enabling candidates to compare their methodologies with professional techniques.

Particularly successful has been the industrial involvement in the section on Working Safely in Science, with many Centres laying on visits or speakers and some giving candidates opportunities to undergo a range of general Health and Safety, Fire Safety and First Aid courses leading to certification. Candidates from some of these Centres have used very commendable, excellent photographic records to embellish their portfolios.

Practical activities seen were varied and usually enabled candidates' achievement at the appropriate level, but were not always applied in nature. The converse was also true; some of

the Centres developing more innovative assignments had not always appreciated opportunities to stretch more able candidates or tailor tasks carefully to the assessment criteria.

Many instances were seen where several B481 activities were encompassed within a broader context. Particularly successful were those developed around a forensic science or brewing scenario. A more carefully chosen context, in many instances, would not only be more within the spirit of the course, but also be more conducive to candidates' achievement at all levels of ability.

For inexperienced Centres, whose approach does not yet have a truly applied feel, a list of suitable practical activities that have been implemented successfully is attached in Appendix I.

Comments on assessment

The vast majority of Centres is applying the assessment criteria appropriately. Some are not, however, apportioning marks to each skill area using the method recommended by OCR, while others are not recording these satisfactorily on the OCR marking grid. An increasing number of Centres has developed a spreadsheet for calculating marks, but Centres must ensure that these are calculating the marks accurately.

As indicated in the specification, in strands a, b and c, and in certain instances in other strands, e.g., the calculations in strand e, assessor annotation of candidate portfolios is essential in the endorsement of the mark band attained. It should be noted that a mark band should be clearly indicated on candidates' work in *each* of the strands b-e for *each* practical activity. Attachment to each portfolio of a completed OCR-recommended grid greatly speeds up the moderation process.

Some Centres are also sending to their moderator copies of the standard procedures assignments undertaken by their candidates. This greatly assists the moderator in judging the degree of guidance given to candidates. It is recommended that *all* Centres do this in future to help to facilitate the moderation process.

Centres encouraging candidates to improve the standard of their work in a single activity in Strands d and e, so as to obtain higher marks, must ensure that the necessary criteria, e.g., appropriate recording of data in Strand d, are addressed *unequivocally*. Centres' attention is also drawn, in particular, to the fact that candidates working towards a Band 3 score must now have a full complement of practical activities at a minimum of Band 1. Candidates working towards Band 3 should be recording and processing data and observations independently and writing conclusions and evaluations without the aid of writing frames or very prescriptive questioning.

A minority of Centres still continues to undertake more than the required number of practicals and also includes superfluous material and notes in candidate portfolios along with, in some instances, several drafts of assignment work. While the latter shows the evolution of the candidate's work, it is unnecessary and may impede the moderation process. Centres should only submit that work which is necessary for inclusion, clearly labelled as each of the designated areas for practical activities.

Strand a
A report on research into working safely in science, including hazards and risks, first aid and fire prevention

In this strand, many candidates' portfolios have been of a very high standard indeed. In some however, Centres have been very generous in their apportionment of marks.

Candidates are assessed on their use of information sources and the quality of the report.

To confirm the range of information sources used, candidates should compile a References' List. At Band 3, this should be written with appropriate detail according to an accepted convention. There should also be some justification as to why each source was used. If including images obtained from a website or textbook in their reports, many candidates are now acknowledging their source, although a number of candidates are presenting photocopied material and material printed directly from the Internet in their portfolios. Centres need to appreciate that the latter is only appropriate for Band 1.

Candidates are also assessed on the quality of the report, which must contain textual *and visual* material at the appropriate level. Those working at Band 3 are expected to demonstrate an in-depth understanding of Health and Safety; arguably this is best demonstrated by the application of the principles of Health and Safety to new situations, for instance reviewing Health and Safety provision on workplace visits.

Strand b
Carry out Risk Assessments

It is recommended that Centres provide appropriate proformas for Risk Assessments and give guidance to the less able candidates so that *all* candidates should produce a workable Risk Assessment. The level of guidance given should then be indicated by teacher annotation. Caution should, however, be exercised in the use of some of the Risk Assessment proformas in published materials. Those listing potential hazards will necessarily limit candidate performance to Band 1.

Risk Assessments were frequently given too generous a mark by Centres. They were often too simplistic and generic; a common fault was to list many generic hazards and their associated risks.

Centres awarding Band 3 for a Risk Assessment should note that it should be *'full'* and *'appropriate'*. For a Risk Assessment to be full, candidates working at higher levels should not be omitting specific hazards to be considered, such as microscopical stains, reagents in qualitative tests, or an indicator in a titration. An 'appropriate' Risk Assessment refers, for instance, to an appropriate match between the concentration of a chemical used and its hazard and associated risk.

Strand c
Follow standard procedures involved in practical tasks using scientific equipment and materials

In some Centres, the confirmation of the competence of the candidate in the selection of equipment and the carrying out of each standard procedure was clearly indicated. Centres had used OCR's 'Certificate of Practical Skills' or simple annotation of candidates' portfolios. A very few Centres, however, are still giving just a single, overall mark of candidate performance, without designating how this is made up. This needs to be addressed by Centres so that moderators can endorse fully the Strand c mark awarded.

Centres should also pay due consideration to Strand d performance when assigning levels to practical competence. Some Centres are awarding high levels for Strand c, when data recorded do not support this, e.g., in titrations.

Strand d
Make observations and obtain and record measurements

Centres are, in general, assessing this strand accurately, though there are some anomalies. Candidates are assessed on the recording and display of observations and measurements, commenting on or carrying out repeats, and on appropriate calculations.

For candidates working at Band 3, all tables and graphs should be appropriately labelled, and units should be included. Data should be recorded to an appropriate and equivalent number of decimal places. For titration readings, for instance, volumes (ideally) should be recorded to the nearest 0.05 cm^3 (or 0.1 cm^3) and all data expressed to two (or one) decimal places. Writing frames should be used with caution. While blank tables and axes of graphs are appropriate for lower ability candidates, their use will preclude achievement of Band 3, and unless the data recorded are particularly complex, e.g., the counts from cells of a haemacytometer, at Band 2 also. When awarding high levels for microscope diagrams, Centres should ensure that candidates are producing these accurately and also, not simply replicating textbook versions.

Graphs should also be drawn for practical activities *where they are appropriate*. Centres have acknowledged that this is not possible in all areas, but some are not looking sufficiently hard for opportunities. Teachers should also check carefully levels awarded to graphs. Some candidates, having confused the plotting of dependent and independent variables, or having omitted units, were nevertheless awarded Band 3 by Centre marking.

To achieve Bands 2 and 3, students must make appropriate calculations:

'Simple' calculations at Band 2 include means, percentages, magnifications (eyepiece x objective lenses) and simple substitution in equations, such as calculation of density.

Manipulating data at Band 3, includes calculations involving the rearrangement of equations (for instance, for titration calculations or V = IR for calculations of electrical resistance), scales on cell diagrams, dimensions of cells and other microscopical observations; cell counts using haemacytometers; calculations of the concentrations of solutions from titrations and the tensile strength of materials.

Centres should annotate candidates' work, indicating the formulae given to make their calculations. Note also that at Band 3, it is essential that candidates have an appreciation of the use of significant figures.

At Band 2, candidates should at least comment on the use of repeats, even if they do not think that they are required. At Band 3, candidates should carry out 'repeats' whenever it is practicable to do so. Should it not be practicable – for instance in destructive testing – class results could be pooled. This is, of course, the very purpose of carrying out standard procedures, so that data are comparable.

Strand e
Analyse and evaluate data

Some Centres are awarding marks too generously in this strand. All candidates should be encouraged to make, at the very least, rudimentary conclusions *and* evaluations to calculations where these are appropriate, to achieve a mark for this strand.

At Band 3, and to a lesser extent at Band 2, candidates should be relating their findings to relevant scientific knowledge and understanding in Unit 2, e.g., explaining, using particle models, why metals are better conductors of heat than polymers. Higher level candidates should also compare, where possible, their findings with those reported in the scientific literature, e.g., values of the densities of different materials.

For candidate evaluations, comments relating simply to how successful the standard procedure was are credited with no more than Band 1. At Band 3, candidates should comment on strengths and weaknesses of the procedure, and be using the terms, 'accuracy', 'precision', 'reliability' and 'sensitivity' when discussing equipment and reagents, along with practical difficulties associated with the procedure and sources of error introduced by themselves, but *not* those produced as a result of carelessness. Suggestions for improvements should be explained at this level.

It was notable in this session that some Centres' candidates had produced excellent portfolios, with sophisticated processing of data and very sound evaluations, but had neglected to include much science in their conclusions.

Appendix I Practical activities undertaken

Microscopy
Preparing temporary slides of banana cells; onion cells
Preparing temporary slides of cheek cells
Examining prepared slides of plant and animal tissues
Yeast cell counts (using haemacytometers)
Comparing fibres
Forensic examination of hair

Microorganisms
Antiseptic and disinfectant sensitivity testing
Investigating the effects of antibiotics on *Escherichia coli* (could also extend to Unit 3)

Qualitative analysis
Identification of unknown salts
Forensic science investigations (testing for anions and cations)
Chromatography of ink

Quantitative analysis
The concentration of ethanoic acid in vinegar
Determining the concentration of citric acid in carbonated drinks

Electrical properties
Determining the resistance of a wire (material used, length, diameter)
Testing wires for their suitability as a heating element
Testing wires for their suitability as electrical cables

Other physical properties
Properties of food packaging materials
Properties of polymers labelled as biodegradable
Properties of insulating materials
The thermal conductivity of materials
Investigating the properties (compressive strength, porosity, density) of mortar made to different specifications

Appendix II Awarding of marks

Unit 1: Awarding of Marks

Strand a:

Working Safely in Science (12 marks)

A report on research into working safely in science including:

Hazards and Risks

First Aid

Fire Prevention

Marks should be awarded as follows:

Band 3:	12 marks for **three** areas at band 3
10-12 marks	11 marks for **two** areas at band 3; the other areas at least band 1
	10 marks for **one** area at band 3; the other areas at least band 1
Band 2:	9 marks for **three** areas at band 2
7-9 marks	8 marks for **two** areas at least band 2
	7 marks for **one** area at least band 2
Band 1:	6 marks for **three** areas at band 1
0-6 marks	3, 4, 5 marks for **two** areas at band 1
	1 or 2 marks for **one** area at band 1

Laboratory notebook

A candidate's laboratory notebook needs to include records of six practical activities – one in each of the following:

- Microscopy
- Culturing organisms
- Qualitative analysis
- Quantitative analysis
- Electrical properties
- Other physical properties

In each strand, for each activity, marks should be awarded as follows:

Strand b: Produce Risk Assessments (6 marks)	
Band 3:	6 marks for **six** completed risk assessments at band 3
5-6 marks	5 marks for **four or five** completed risk assessments at band 3; one at least band 1
Band 2:	4 marks for **six** completed risk assessments at, at least band 2
3-4 marks	3 marks for **three, four or five** completed risk assessments at, at least band 2
Band 1:	2 marks for **six** completed risk assessments at, at least band 1
0-6 marks	1 mark for **two, three, four or five** completed risk assessments at, at least band 1

Strand c: Follow standard procedures involved in practical tasks using scientific equipment and materials (8 marks)	
Band 3:	8 marks for **six** completed activities at band 3
7-8marks	7 marks for **four or five** completed activities at band 3
Band 2:	6 marks for **five or six** completed activities at, at least band 2
4-6 marks	5 marks for **four** completed activities at, at least band 2
	4 marks for **three** completed activities at, at least band 2
Band 1:	3 marks for **five or six** completed activities at, at least band 1
0-3 marks	2 marks for **three or four** completed activities at, at least band 1
	1 mark for **one or two** completed activities at, at least band 1

Strand d: Make and record observations and / or measurements, present and process data (12 marks)	
Band 3: **9-12marks**	12 marks for **six** completed activities at band 3 11 marks for **five** completed activities at band 3; the other activity at least band 1 10 marks for **three or four** completed activities at band 3; the other activities at least band 1 9 marks for **one or two** completed activities at band 3; the other activities at least band 1
Band 2: **6-8 marks**	8 marks for **five or six** completed activities at band 2 7 marks for **three or four** completed activities at band 2 6 marks for **one or two** completed activities at band 2
Band 1: **0-5 marks**	5 marks for **six** completed activities at band 1 4 marks for **five** completed activities at band 1 3 marks for **three or four** completed activities at band 1 2 marks for **two** completed activities at band 1 1 mark for **one** completed activity at band 1

Strand e: Draw conclusions and evaluate data (12 marks)	
Band 3: **8-12 marks**	12 marks for **six** completed activities at band 3 11 marks for **five** completed activities at band 3; the other activity at least band 1 10 marks for **three or four** completed activities at band 3; the other activities at least band 1 9 marks for **two** completed activities at band 3; the other activities at least band 1 8 marks for **one** completed activity at band 3; the other activities at least band 1
Band 2: **5-7 marks**	7 marks for **five or six** completed activities at band 2 6 marks for **three or four** completed activities at band 2 5 marks for **one or two** completed activities at band 2
Band 1: **0-4 marks**	4 marks for **six** completed activities at band 1 3 marks for **five** completed activities at band 1 2 marks for **three or four** completed activities at band 1 1 mark for **one or two** completed activities at band 1

Appendix III Recording of marks

Candidate					
Developing scientific skills					
	a	**b**	**c**	**d**	**e**
	Working safely in science	**Risk assessment**	**Follow procedure**	**Record display process data**	**Conclusion and evaluation**
Hazards and risks					
First Aid					
Fire Prevention					
Microscopy					
Culturing organisms					
Qualitative analysis					
Quantitative analysis					
Electrical properties					
Physical properties					
Mark for strand					
TOTAL for unit					

B482/01: Applied Science: Double Award, Foundation Tier

General Comments

The foundation tier paper is designed to test the knowledge and skills of candidates performing at grades GG to CC. In this session, candidates were appropriately entered for the foundation tier paper; most showed knowledge across all question areas. Candidates made good use of time and very few part questions were left unattempted.

Teacher's tip:

Candidates aiming at a grade CC should be entered for the foundation tier paper where they will be able to show what they know and can do. The higher tier paper is designed to differentiate between higher grades.

This year, candidates showed a particularly high level of skill in processing information from the question 'stems' and using the information to support their answers.

Comments on Individual Questions

1 This question was an introductory question and, along with the other earlier questions on the paper, was designed to test achievement between grades GG and EE.

Candidates answered this question well, with many gaining almost full marks.

a In (i), most candidates gained all three marks for identifying the reasons why plants grow well in the tank. Most common errors were to identify 'they have water' or 'they have gravel'. In (ii), most knew that the plant process was photosynthesis. Most identified at least one of the two products of photosynthesis in (iii) but 'nitrogen' was a common incorrect choice.

b All candidates attempted this question, but it was clear that some were guessing. All answers were seen. Not all knew that nitrogen and phosphorus were needed.

c Most either said that the fish would eat the plants or identified a reason why the tank would be unlikely to keep the fish alive, e.g., too high a concentration of carbon dioxide or nutrients. Some said that the light or the temperature would be harmful to the fish – these answers did not score.

2 This question was also aimed at lower demand and again, this question was high scoring. The candidates often did not structure their answers well enough to gain the multiple marks in the longer answer part-questions, e.g., a iii) and c.

a Most knew that poly(ethene) is a polymer, although the context of the grass pitch confused some candidates who chose 'composite' as their answer. In (a) (ii) candidates found the 'true-false' exercise surprisingly challenging, most only gaining a single mark. Common incorrect choices were that poly(ethene) does rot and is not made from crude oil. For part iii, most candidates gave at least one advantage of the poly(ethene) pitch over the grass pitch, but many failed to identify two clear points.

b Surprisingly few candidates knew that poly(ethene) softens or melts when it is heated. It 'changes shape' was a common incorrect response.

c This is a new area of the specification and candidates seemed to struggle for ideas. Most gained a single mark for identifying 'testing', but most talked vaguely about 'finding out about the pitches' or 'finding which one is the best'. They key idea to focus on is the actual tasks that scientists do when they contribute to the development of a new product.

Teacher's Tip

When students do their case studies for Unit 3, take time to consolidate this area of Unit 2 material. They need to be able to discuss the role of scientists in development and testing of new materials.

3 a Almost all knew that the process was fractional distillation.

b Most candidates could identify at least one of the features of fractional distillation. Many were tempted by 'the process produces compounds for fertilisers'.

c Examiners were generous in their marking of this question. Identifying any of the fuels for use 'in cars' gained a mark. However, very few candidates were able to suggest any use for any of the products other than 'in cars'. Some gained marks by choosing heavier alkane fuels and saying that these were used in aeroplanes or lorries, but very few identified any of the chemical industry uses of the fractions.

d As in previous years, the meaning of the term 'organic' is not well known. 'Produced naturally' or 'doesn't use fertilisers' are the commonest incorrect answers. Organic chemicals defined as containing carbon was not known by many. Similarly, few identified methane as an organic compound. Most chose water.

e This is another recent addition to the specification and was not well answered by candidates. Many give vague responses about 'causing pollution' or 'harming the environment'. Others missed the fact that the rigs are in the sea and talked about problems on the land. In (ii), many thought that a local oil rig meant cheap or free fuel for local people!

Teacher's Tip

If your centre has been teaching the course for a few years, cross check the specification against your teaching scheme to make sure that newer additions to the specification are covered in the scheme. Section 6 is the main addition, but minor changes occur throughout the new document.

4 This question was the last of the lower demand questions on the paper. Most candidates scored about half marks.

a Surprisingly few candidates knew that oxygen and nitrogen are the main gases in the atmosphere. Many thought that 'carbon dioxide' was one of the main gases (this is covered in the newer Section 6 of the specification).

b Very few candidates identified the missing EM regions as visible and radio. This was very poorly known. To define 'frequency' most gave an 'everyday' meaning such as 'how often something happens'.

Teacher's Tip

Some students respond well to the use of glossaries or cards with definitions of key words. They can produce these as a revision exercise at the end of each section. Key word cards can be used for matching games, 'Taboo' games or crosswords to help to reinforce their meaning.

c Most candidates scored at least 3 marks here. The commonest error was to choose 'moving' rather than 'expanding' to explain why galaxies are moving away from us.

5 This question was an 'overlap' question which also appeared on the higher tier paper. It was designed to test achievement at CC and DD grades. Consequently, it was difficult for many foundation tier candidates. Very few scored more than about a third of the available marks.

a This was well answered. Almost all candidates knew the means of transfer of microorganisms, e.g., touching, transfer through air, blood, cuts or saliva.

b The specification lists examples of diseases linked to the relevant microorganism that candidates need to know. Not many knew that measles is caused by a virus.

Teacher's Tip

This is another area of the specification that lends itself well to a card matching game. Put names of diseases on one set of cards and the microorganisms that cause them on a second set. Ask candidates to practise matching them up.

c The mechanism for the action of a vaccine was not well known by foundation tier candidates. Most discussed injecting with a 'small amount' of virus rather than a dead or weakened form. There was a great deal of confusion between antibodies and antigens. Many thought that the vaccine 'protects you against disease' rather than stimulating the immune system in the body to generate its own protection.

d The choices of outcomes for a damaged heart were not always correctly chosen. Many thought a damaged heart reduced lung capacity.

6 The last question on the paper was also targeted at grades DD to CC. Again, foundation tier candidates found this question very difficult. Many failed to score more than two or three marks.

a This question involved finding two relevant readings on the diagram and using them to calculate a difference. This two-step problem proved too difficult for most foundation tier candidates. In (ii), the comparison that the question was asking the candidates to make was between wood and metal framed windows. In order to do this, they needed to use the data from the 'bad house' windows. Many confused themselves by comparing the wood frame on the bad house to the *double glazed* wood frame on the good house. This implies that they had not taken enough time to process the information on the diagram before starting to write their answers. Part (iii) was much more successfully attempted.

Teacher's tip

This is a good question to use in class to reinforce the importance of reading information in question 'stems' carefully. The answers to all of (a) could be interpreted by using the provided information.

b This question demanded that candidates process new information and carry out a calculation. This proved difficult for most foundation candidates with only a few gaining either of the two available marks.

c Candidates did not usually identify convection as the transfer process involved in air leakage.

d Commonly, candidates did not refer to the diagrams to answer this question. The correct answer was 'single glazed window, wood frame'. The commonest incorrect answer was 'the roof', implying that they were guessing from their knowledge rather than reading the information. Very few knew that infra-red is used in thermal imaging.

B482/02: Applied Science: Double Award, Higher Tier

General Comments

The Higher tier paper is designed to test the knowledge and skills of candidates performing at grades CC to A*A*. There was evidence to suggest that a significant number of candidates were inappropriately prepared for the higher tier paper. In particular, many appeared unfamiliar with specification content specifically identified as higher tier.

Candidates made good use of time with very few part questions left blank. Candidates being prepared for the higher tier need to be familiar with the higher tier content; some apparently able candidates were making intelligent guesses at answers without the scientific knowledge that would have helped. It is expected that candidates on the higher tier are able to give appropriate definitions or explanations of scientific terms in the specification. This was a general weakness, with very few being able to give more than a vague suggestion of the meaning of words such as 'alloy' and 'heterozygous'.

Teacher's tip:

Candidates aiming at a grade CC should be entered for the foundation tier paper where they will be able to show what they know and can do. The higher tier paper is designed to differentiate between higher grades and many of the questions require knowledge specific to the higher tier and many questions require candidates to analyse and present answers at a much higher level than on the foundation paper.

Comments on Individual Questions

1 This question was an 'overlap' question which also appeared on the foundation tier paper. It was designed to test achievement at C and D grades. Consequently, it should be straightforward for higher foundation tier candidates. Many candidates scored more than half marks.

- a Most candidates correctly calculated 1.35 in part (i); the most common error was 0.35. In part (ii) weaker candidates answered the question in terms of 'insulation'. Unfortunately this had been given in the question; what was required was how the better insulator could be identified from the data given. In part (iii) Many candidates gained both marks; weaker candidates did not read the question carefully and gave answers that did not relate to the change in U-value for the roof.
- b This was generally well answered, with part (ii) proving a little more challenging than part (i)
- c Many candidates correctly identified convection, with conduction being the most common error.
- d Many candidates correctly identified the metal framed window. However, the most common error was the roof, which suggests candidates where not using the data provided in the question. Few knew that thermal imaging depends on infrared radiation.

2 This question was an ‘overlap’ question which also appeared on the foundation tier paper. It was designed to test achievement at C and D grades. As such, it should be straightforward for higher foundation tier candidates. Many candidates scored more than half marks.

a Most candidates identified at least one factor or mechanism contributing to the transmission of the disease between the wrestlers. Many identified the lack of contact as the reason the referee was less likely to catch a disease from the wrestler, but this was often very poorly expressed.

b Surprisingly few candidates identified measles as a viral disease, with the most common error being ‘tuberculosis’.

c The descriptions of how vaccination works where better than in previous sessions. The most common error in good answers was the use of small amounts of virus in the vaccine. Weaker candidates muddled the role of white blood cells, antigens and antibodies. The weakest candidates often simply referred to a ‘jab’ killing the disease. In part (ii) the common error was to suggest the wrestler could be treated, rather than stopped from wrestling.

d Few candidates were able to identify the effects of a damaged heart. The answers given did not show any particular pattern, with each answer being selected on many occasions.

3 a Very few candidates knew that an alloy was a mixture of metals. Almost none could explain about different sized atoms and slipping planes.

b Very few candidates drew cross links. Some where aware that the water was driven off by heating and a few drew the layers close together. A common misunderstanding was to use the water molecules as some form of cross link between layers. In part (ii) many candidates identified the key features, e.g., heat resistance or strength, but almost none could explain how these properties related to structure.

c Knowledge of bonding was very weak; few could identify the type of bond as covalent, and almost none could describe a covalent bond. However, most candidates knew the number of protons was the same as the number of electrons in the oxygen atom.

4 a Many candidates realised that the question was about gases in the atmosphere, with oxygen and carbon dioxide being the most common correct answers. However, a significant minority were unable to interpret the question and common errors were light and radio waves. On the higher tier, candidates will be expected to answer questions in novel contexts.

b Many candidates appeared to think wavelength and frequency were axes at right angles. Very few candidates knew about the inverse relationship between wavelength and frequency. The most common correct answer was with wavelength pointing right.

c There was little knowledge of the spectrum. Some candidates failed to understand the question at all and gave gases in the atmosphere. The most common errors were light and radio, suggesting these candidates misread the vertical axis of the graph as transmission rather than absorption. Long wave radio was accepted as an answer.

d The calculation was beyond most candidates. Very few could quote the wave equation. A few realised they had to multiply the wavelength by the frequency, but very few could cope with the number expressed in standard form. The correct answer was 300,000,000 m/s (3×10^8 m/s).

e Most commonly correct were the number of stars in the galaxy and the distant to the nearest star. The size of the solar system proved more challenging, with 1000 and 4 light years being the most common errors.

5 a Many candidates managed to identify the inherited aspect of a genetic disorder in part (i), but fewer clearly expressed that genes were involved. In part (ii), many candidates clearly had no idea of the meaning of the terms in the list. Some stronger candidates missed that the cystic fibrosis gene must be the recessive allele, mixing recessive and dominant in the answer. Very few correctly identified the combination of different alleles as heterozygous.

b Many candidates correctly completed the Punnett square; however, the quite frequent appearance of F^2 and f^2, suggested that this may have been based on mathematical, as opposed to scientific knowledge. Almost none could identify a gamete or knew meiosis produced gametes. Very few identified the double recessive as giving rise to cystic fibrosis, but most who did also identified the probability as 1 in 4.

6 a Fractional distillation was very rarely given.

b Many candidates knew that the compounds had different boiling points, but few knew they condensed at different temperatures. The errors appeared to be spread evenly between the distracters.

c Many candidates correctly identified $C_{40}H_{82}$ as having the highest boiling point, but were unable to explain why, even with the direction to intermolecular forces. The most common error in part (iii) was composite, presumably confusing with ‘compound’. When organic was chosen, the reason appeared to be related to coming from the ground, rather than containing carbon atoms.

B483: Science at Work (Portfolio)

General Comments

In this session, the majority of Centres is to be commended for the way in which this unit has been implemented and delivered. Administration has, on the whole, been efficient, though Centres must guard against arithmetical errors when calculating final marks for the units, and clerical errors in the transfer of these onto the OCR Interchange or MS1s.

Centres must also make careful checks on the way the assessment criteria are being translated into marks; this was particularly apparent in this unit. It is also recommended that mark bands for each criterion, for each strand, are also recorded carefully for the benefit of the moderator. Guidance on this, from the specification, is reproduced in Appendices II and III. Any Centres that might remain unsure of how to apply the assessment criteria accurately should seek further guidance from OCR.

In this session, many Centres had ensured that internal standardisation procedures had been carried out, and documentary evidence of this was supplied. In a minority, however, the lack of these procedures was evident in inconsistent marking between different teachers, and this is an important issue that has to be resolved.

For B483, it was again apparent that Centres had ensured diligently that candidates had fulfilled the requirements of the assessment evidence grids, but it should also be noted that due consideration should be paid to appropriate coverage of the Assessment Objectives of the unit (Centres should refer to page 97 of the specification), and Performance Descriptions (pages 114 and 115). One important issue observed in write ups of standard procedures by higher ability candidates was that in many instances, only a limited attempt had been made to relate experimental findings to scientific principles (AO2).

For practical activities, Centres should also ensure that candidates working at higher levels use good scientific practice and ensure that data are recorded appropriately. Tables, for instance, must be correctly labelled and include units, and candidates should have an appreciation of the use of significant figures. Conclusions at higher levels must relate findings to background science and evaluations must use appropriate scientific terminology. Centres' attention is also drawn, in particular, to the fact that candidates working towards a Band 3 score must now have a full complement of practical activities at a minimum of Band 2.

Centres should also take particular note of the presentation of candidates' portfolios. It would greatly assist the moderation process if candidates' portfolios were presented in cardboard wallets or cut-flush folders, or bound with treasury tags; please do not enclose portfolio material in plastic wallets.

Strand a
A report on how science is used in the workplace

Some good work was seen, but there still tends to be an over-reliance on corporate websites, as often the sole information source. While websites such as http://careersadvice.direct.gov.uk/ and http://www.connexions-direct.com often give an excellent introduction to careers, and information on qualifications required for those careers, they should be used as stimulus material, and not the principal reference. Higher scoring candidates should also be explaining the significance of these qualifications and skills. It was noted in this session that Centres with excellent links with the world of work did not exploit these to the full.

Note that after the initial overview of science in the workplace at Band 1 (and note that this is limited to Band 1), candidates should then study **two** organisations in detail. Attention is drawn to the hierarchy among the criteria; candidates are often identifying at Band 1, describing at Band 2, and giving explanations at Band 3. An *explanation* of the importance of the work carried out by an organisation is often easier when supported by statistical data.

More emphasis should also be placed on investigating the *science* used by these workplaces, particularly in candidates working towards higher levels. Some candidates had researched very carefully scientific reasons for the siting of industries, and are realising the implications of this in working with other subject areas. Note that there is no requirement to address *all* reasons cited for the location of an organisation, i.e., scientific, economic, social and environmental, for *both* of those studied.

Strand b
The production of pure, dry samples from two types of chemical reaction

This strand has been well-covered, with candidates in all Centres carrying out appropriate chemical reactions.

For criterion 1, the type of reaction was often not mentioned at all, however, and the level of science required when discussing the chemical reaction involved was sometimes underestimated at Bands 2 and 3. Centres should annotate portfolios to indicate that a symbol equation has been balanced by the candidate, or evidence should be presented that demonstrate that the candidate has a clear understanding of how to balance the equation.

A key feature of portfolios of candidates working towards higher levels is that reports should be carefully produced, and not contain simple errors, such as the confusion of lower and upper case, and subscript and superscript in chemical formulae. It is also essential that higher scoring candidates should not use very prescriptive writing frames.

Evaluations were often too simplistic to be awarded Band 3.

Many Centres have found criterion six – a review of the energy inputs and the treatment of wastes in the industrial version of the process - difficult to address, but some have now found appropriate information sources. Some interesting interpretations of this criterion were seen this session, along with excellent information sources, and Centres are to be commended.

Strand c
A report on the assembly and assessment of the effectiveness of one electronic or optical device

In this strand, Centres should ensure that discussions of the use of electronic devices and components are not too superficial, and note that *explanations* of why these components are used should be given at Band 3. Candidates should also review a wider series of components than just those used in their device.

Assessing the performance of electronic circuits, at Bands 2 and 3, should ideally include the collection of numerical data, and Centres should ensure that evaluations are carried out to a level appropriate to the ability of their candidates. For electronic devices, the best activities tended to involve the construction of potential divider circuits, which also enabled candidates to discuss the scientific principles involved. Some excellent work was seen involving the construction of telescopes.

Strand d
A report on mechanical devices

In this strand, Centres should ensure that all units are included in tables for candidates working at higher levels.

It should also be noted that for candidates to achieve the full six marks, there is a requirement to investigate the performance of a second, commercial device. Although this is ideally carried out on a practical basis, it could be done using secondary data. Candidates working at Band 3 are expected to evaluate the performance of the devices as well as making efficiency calculations.

Strand d
A report on monitoring the growth/development/response of an organism

In this strand, Centres had chosen an interesting range of organisms to monitor. Candidates in many Centres sometimes neglect their discussions of the reasons for monitoring the organism. Centres should also ensure that candidates working at higher levels display data appropriately and relate their findings to scientific principles. Discussions should, however, be fully integrated into their conclusions; often much physiological information is included simply as a ‘bolt-on’. The calculation of growth rates is often a way of addressing criterion four at Band 3, though come Centres, commendably, are introducing statistics into their analyses of data at this level.

Evaluations were usually marked generously.

Some very detailed studies indeed were seen in this section, and overall, Centres are to be commended.

Appendix I Practical activities undertaken

The production of pure, dry samples from three types of chemical reaction

Redox:	displacement of copper from copper sulfate
	preparation of copper from malachite/copper oxide
Neutralisation:	preparation of potassium nitrate
	preparation of ammonium sulfate/nitrate
Precipitation:	preparation of lead chromate
	preparation of zinc carbonate/hydroxide
	preparation of silver halides
	preparation of barium sulfate
Esterification:	preparation of esters

A report on the assembly and assessment of the effectiveness of one electronic or optical device

Simple potential divider circuits
Monitoring light and temperature in a greenhouse
A night light
Making a transparency meter

A report on mechanical devices

Investigating levers, pulleys and gears
Investigating gym equipment
Investigating the car jack

A report on monitoring the growth/development/response of an organism

Monitoring yeast growth (in bread and alcoholic drinks)
Monitoring human performance
Monitoring the growth of cress seedlings
Monitoring the growth of mould
Monitoring the behaviour of primates
Monitoring the germination of seeds
The effect of auxins on plant growth

Appendix II Awarding of marks

Unit 3: Awarding of Marks

In each strand, marks should be awarded as follows:

Strand a: A report on how science is used in the workplace (11 marks)	
Band 3:	11 marks for **five** criteria at band 3
9-11 marks	10 marks for **four** criteria at band 3; the **other** criterion completed at band 2
	9 marks for **two or three** criteria at band 3; the **other** criteria completed at band 2
Band 2:	8 marks for **five** criteria at, at least band 2
6-8marks	7 marks for **four** criteria at, at least band 2
	6 marks for **two** or **three** criteria at, at least band 2
Band 1:	5 marks for **six** criteria at, at least band 1
0-5 marks	4 marks for **five** criteria at, at least band 1
	3 marks for **four** criteria at, at least band 1
	2 marks for **two or three** criteria at, at least band 1
	1 mark for **one** criterion at band 1

Strand b: **The production of pure, dry samples from two types of chemical reaction (13 marks)**	
Band 3: **10-13 marks**	13 marks for **six** criteria at band 3 12 marks for **five** criteria at band 3; the **other** criterion completed at band 2 11 marks for **three or four** criteria at band 3; the **other** criteria completed at band 2 10 marks for **one or two** criteria at band 3; the **other** criteria completed at band 2
Band 2: **6-9 marks**	9 marks for **six** criteria at least band 2 8 marks for **five** criteria at least band 2; the **other** criterion completed at band 1 7 marks for **three** or **four** criteria at least band 2; the **other** criteria completed at band 1 6 marks for **one** or **two** criteria at least band 2; the **other** criteria completed at band 1
Band 1: **0-5 marks**	5 marks for **six** criteria at band 1 4 marks for **five** criteria at band 1 3 marks for **four** criteria at band 1 2 marks for **three** criteria at band 1 1 mark for **one or two** criteria at band 1

Strand c: A report on the assembly and assessment of the effectiveness of one electronic/or electrical or optical device (7 marks)	
Band 3: **6-7 marks**	7 marks for **three** criteria at band 3 6 marks for **one or two** criteria at band 3; the **other** criteria/criterion completed at band 2
Band 2: **3-5 marks**	5 marks for **three** criteria at band 2 4marks for **two** criteria at band 2; the **other** criterion completed at band 1 3 marks for **one** criterion at band 2; the **other** criteria completed to band 1
Band 1: **1-2 marks**	2 marks for **three** criteria at band 1 1 mark for **one or two** criteria at band 1

Strand d: A report on mechanical devices (6 marks)	
Band 3:	6 marks for **three** criteria at band 3
5-6 marks	5 marks for **one or two** criteria at band 3; the **other** criterion/criteria completed at band 2
Band 2:	4 marks for **three** criteria at band 2
3-4 marks	3 marks for **one or two** criteria at band 2; the **other** criteria/criterion completed at band 1
Band 1:	2 marks for **three** criteria at band 1
1-2 marks	1 mark for **one or two** criteria at band 1

Strand e: A report on monitoring the growth/development/response of an organism	
Band 3:	13 marks for **six** criteria at band 3
9-13 marks	12 marks for **five** criteria at band 3; the **other** criterion completed at band 2 11 marks for **four** criteria at band 3; the **other** criteria completed at band 2 10 marks for **three** criteria at band 3; the **other** criteria completed at band 2 9 marks for **one or two** criteria at band 3; the **other** criteria completed at band 2
Band 2:	8 marks for **six** criteria at band 2
5-8 marks	7 marks for **five** criteria at band 2; the **other** criterion completed at band 1 6 marks for **three or four** criteria at band 2; the **other** criteria completed at band 1 5 marks for **one or two** criteria at band 2; the **other** criteria completed at band 1
Band 1:	4 marks for **five or six** criteria at band 1
0-4 marks	3 marks for **four** criteria at band 1 2 marks for **three** criteria at band 1 1 mark for **one or two** criteria at band 1

Appendix III Recording of marks

Unit 3: Science at work	**Centre:**
Candidate:	

Strand a

Science in the workplace

Criterion		Mark Band
1	Identify careers	
2	Work carried out by organisation	
3	Location of organisation	
4	Job titles and qualifications	
5	Use of science	
6	Quality of report	
Total		

Strand b

Chemical reactions

Criterion		Reaction		Mark Band
		1	2	
1	Type or reaction			
2	Products/reactants/equation			
3	Obtain product			
4	Calculation of yields			
5	Evaluation			
6	Energy input/waste disposal			
Total				

Strand c

Electronic/optical device

Criterion		Mark Band
1	Uses of electronic/optical devices	
2	Assemble device	
3	Evaluate device	
Total		

Strand d

Mechanical device

Criterion		Mark Band
1	Types of mechanical devices and components	
2	Assemble/ investigate performance	
3	Calculations of performance	
Total		

Strand e

Monitoring an organism

Criterion		Mark Band
1	Identify organism	
2	Produce plan/ monitor organism	
3	Record measurements/ observations	
4	Present and process data	
5	Explain findings	
6	Evaluate monitoring process	
Total		

Total for unit:

Grade Thresholds

General Certificate of Secondary Education
Applied Science (Double Award) J649

June 2009 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A*	A	B	C	D	E	F	G	U
B481	Raw	50	45	42	39	36	29	22	16	10	0
	UMS	100	90	80	70	60	50	40	30	20	0
B482/1	Raw	60				34	28	22	17	12	0
	UMS	69				60	50	40	30	20	0
B482/2	Raw	60	40	34	28	22	18	16			0
	UMS	100	90	80	70	60	50	45			0
B483	Raw	50	47	43	39	36	29	23	17	11	0
	UMS	100	90	80	70	60	50	40	30	20	0

Entry Information

Unit	Total Entry
B481	6738
B482/1	5298
B482/2	1804
B483	8948

Specification Aggregation Results

	A*A*	A*A	AA	AB	BB	BC	CC	CD	DD	DE	EE	EF	FF	FG	GG
UMS	270	255	240	225	210	195	180	165	150	135	120	105	90	75	60
Cum %	0.2	0.8	2.2	5.0	10.6	21.3	41.9	60.3	72.1	80.5	87.3	92.5	96.0	98.1	99.2

9286 candidates were entered for aggregation this series.

For a description of how UMS marks are calculated see;
http://www.ocr.org.uk/exam_system/understand_ums.html

Statistics are correct at the time of publication.

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